



Overview of Retrofit Programs in the Northeast

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Presentation Overview

- Importance of reducing in-use diesel emissions
- Overview of existing retrofit programs
- Specifics on several projects
- Policies for reducing diesel emissions
- Conclusions

Diesel Emission in the Northeast

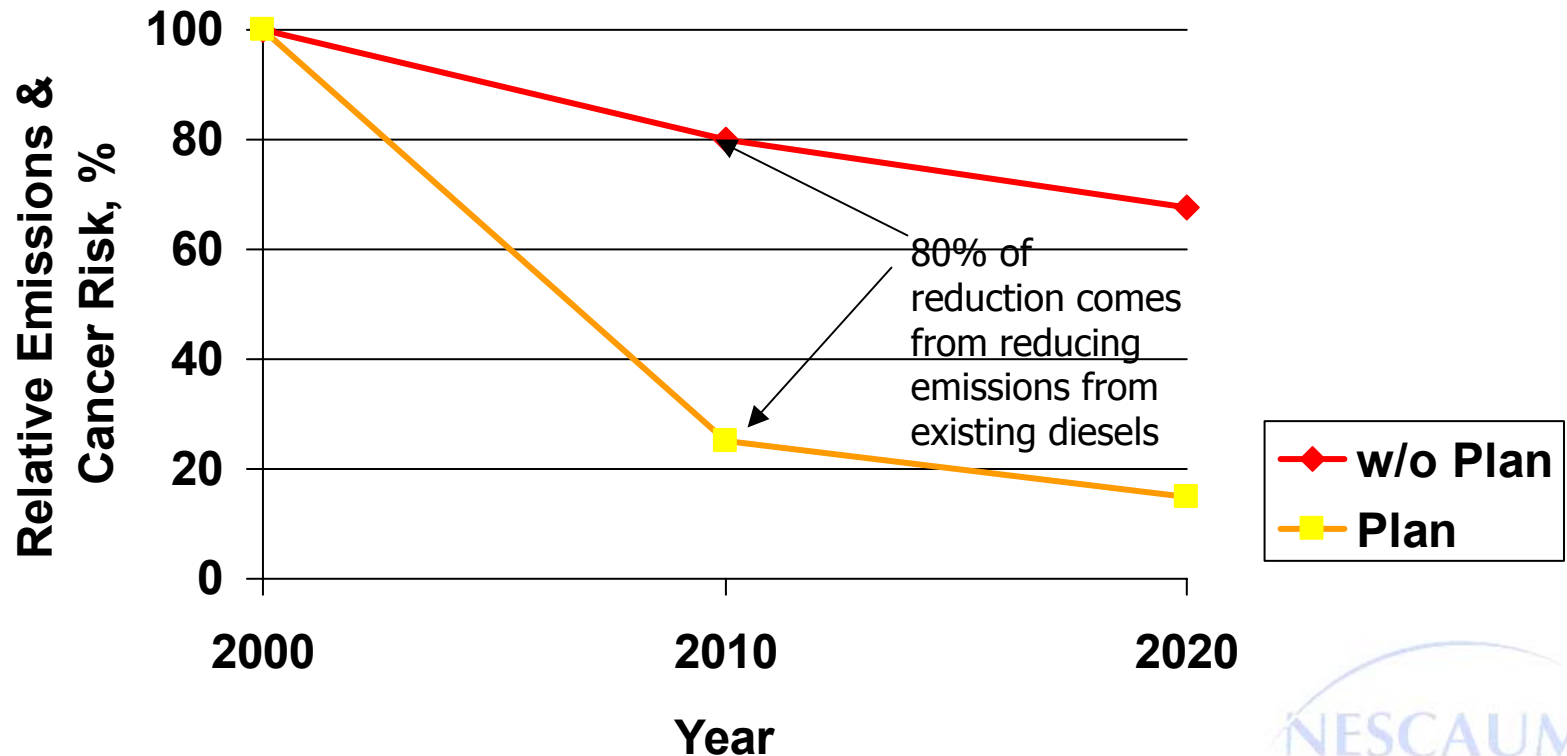


- 1/3 of total NO_x emissions in the region
- Up to 80% of mobile source particulate emissions
- Contribute significantly to toxic emissions - such as formaldehyde, and acetaldehyde

Importance of Reducing In-Use Diesel Emissions

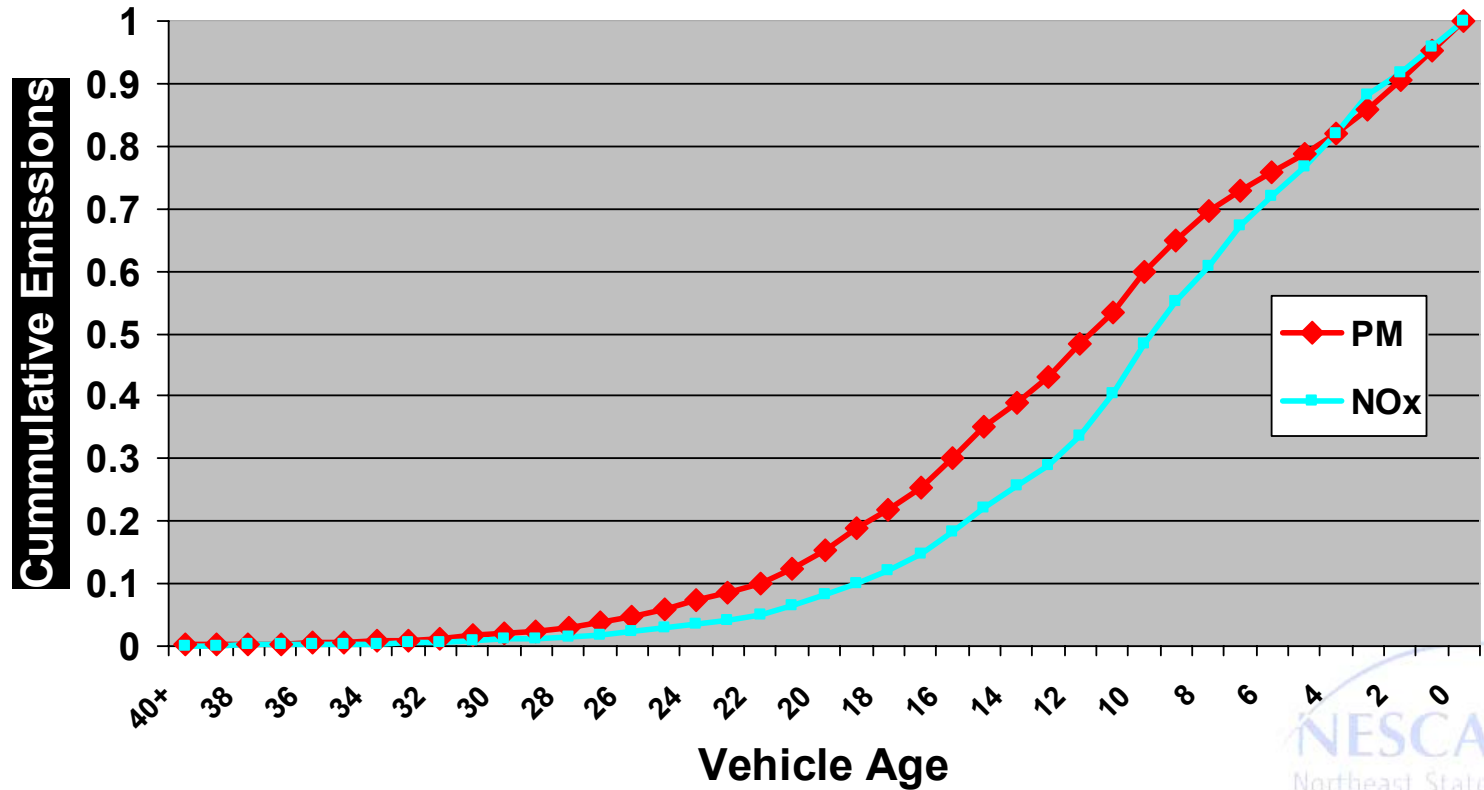
- Durability of diesel engines means that “legacy” diesels will be in operation for many years
- Older engines were manufactured to less stringent emissions standards
- Even retrofit of relatively new engines can yield substantial reductions - especially for nonroad engines
- A substantial fraction of emissions inventory is from legacy engines

Importance of Cleaning Up In-use Diesels



Source: CARB

Cumulative Emissions By Age – Diesel Trucks



Source: CARB

Examples of Vehicles/Equipment that have been retrofitted

- Construction equipment
 - Big Dig, Boston
 - 7 World Trade Center, NYC
 - Q-Bridge, CT
 - NYNJ Port tenant operated construction equipment
- Sanitation trucks - DSNY
- Refuse collection trucks
 - Waste Management
- Long haul trucks
 - UPS - SCR/DPF demonstration
 - truck stop electrification
- Delivery trucks – Clem Snacks, NYC



Retrofit examples (continued)

- Tour buses
 - Coach USA
 - New York Downtown Alliance
- Urban buses
 - NYCTA
 - MBTA
- Ferries
 - Staten Island ferry
 - Private ferries in New York Harbor
- School bus retrofit projects
 - Norwich, New Haven, Hartford, Bridgeport, CT
 - Boston, Medford, MA
 - Maine
 - Camptown, NJ



World Trade Center Retrofits

- 8 pieces of equipment
- Retrofit technology: oxidation catalysts
- Installation had to fit with demanding work schedules for equipment
- Backhoe, excavator, tower crane, generator, genset, and others

DOC retrofit – Tower Crane, 600HP Cummins (16L)



Off-Road - Construction

PANYNJ – World Trade Center Path Station Rebuild



2 Caterpillar Loaders

ULSD, JMI DPF


Caterpillar Genset

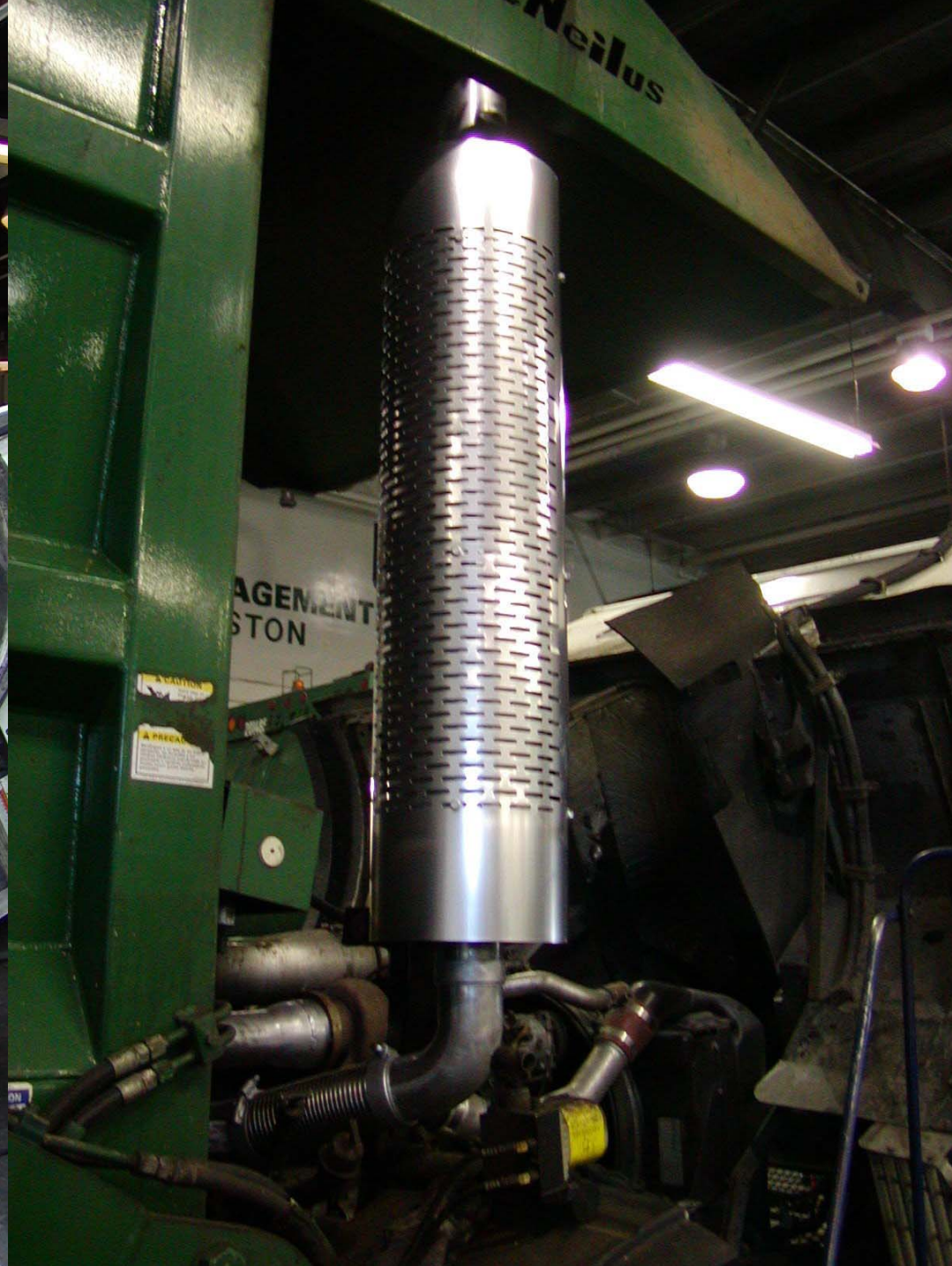
ULSD

Retrofit Technology At A Glance - DPF

Benefits	Drawbacks
<ol style="list-style-type: none">1. Very high total PM reduction performance (90%).2. Comparatively easy installation – not as straightforward as the DOC.3. Passive regeneration is unnoticed by the vehicle operator.	<ol style="list-style-type: none">1. Cost.2. Requires ULSD.3. Requires threshold exhaust temperature to ensure regeneration.4. Requires periodic (usually yearly) removal and cleaning to remove unregenerated ash deposits.5. Weight/"mounting".

Mack Truck SEP

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- A line of Mack heavy-duty diesel trucks is parked in a lot. The trucks are white with black accents and are equipped with large exhaust stacks. The image is slightly faded to allow the text overlay to be visible.
- Install 158 diesel oxidation catalysts (DOC)
 - Install 30 diesel particulate filters (DPF)
 - Purchase and put into service ten selective catalytic reduction (SCR) heavy-duty diesel trucks
 - Purchase and put into service five combination SCR and DPF trucks



Department of Sanitation New York

- Retrofitted 70 vehicles with DPFs
- 2 trucks retrofitted with SCR
- 1 million miles in service
- Demonstrated that DPFs can work for this application in cold weather





Marine engine retrofits

- Staten Island ferry (Alice Austin)
 - propulsion engine: 1986 Caterpillar 3516a (2 engines)
 - NOx reduction: 16 tpy
 - Retrofit technology: SCR
- New York harbor private ferries
 - DPF, DOC and other technologies



Technologies Used

- Selective Catalytic Reduction (SCR)
- Particulate Filters (DPF)
- Oxidation Catalyst (DOC)
- Fuels changes
 - Ultra low sulfur diesel (ULSD)
 - Emulsified diesel
 - others
- Crankcase
- Others



Emissions Reductions

- DPF - 90% PM reduction
- DOC - 25% PM reduction, up to 90% HC and CO reduction
- SCR - 70% - 90% NOx reduction
- emulsified diesel - 20% NOx reduction, ~30% PM reduction
- Other technologies include crankcase retrofit kits, biofuels, replacement, rebuilding, idling reduction



Technology Match: Issues to Consider

- Duty cycle (exhaust temperatures) important for technology match
- Space constraints must be considered
- Equipment/vehicle operator view
- Weight (additional brackets sometimes necessary)
- Down time constraints
- Fueling arrangements



Examples of Retrofit Policies

- Quasi-mandatory
 - contractual requirements
- Mandatory
 - California retrofit regulations
 - New Jersey retrofit legislation
 - Local Law 77 in New York
- Voluntary
 - state agency retrofit commitments
 - EPA Retrofit program



California Retrofit Program

- Transit buses 2000
- Refuse haulers 2003
- Truck TRUs 2004
- Portable engines 2004
- locomotive/harbor craft fuel 2004
- Stationary engines 2003
- Bus/truck idling 2002/4



California Regulatory Approach

- Replace older engines
 - Re-power
 - New vehicle
- Retrofit mid-aged engines
 - Filters 85% PM reduction
 - Catalysts 25% PM reduction
 - Other 50% PM reduction



Conclusions

- Engines from many sectors have been retrofitted - resulting in significant reductions in PM, NO_x, and toxics.
- Substantial technical data have been gathered on which technologies can be used in different circumstances.
- Technical retrofit issues exist (temperature, space) that require a careful evaluation of the engine/retrofit technology combination.



Conclusions (continued)

- Emissions reductions can be achieved for most - if not all - engines.
- Widespread availability of cleaner diesel fuel in 2006 will facilitate retrofits.
- Substantial additional reductions can be achieved from the existing fleet of highway and nonroad diesels.